A REPORT ON THE TROPHIC STATUS OF PELICAN LAKE

(1979 - 1982)

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ACKNOWLEDGEMENTS

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INTRODUCTION

The Public Participation Program was initiated in 1978 in response to requests for water quality information by concerned cottage owners on many of the recreational lakes in Manitoba. Previous studies have shown that the enrichment (trophic) status of a lake can be estimated by the use of Secchi disc readings (transparency) and chlorophyll a concentrations (the green pigment in algae) which indicate water clarity and algal densities, respectively. The determination of the trophic status of lakes is vital to the classification of those lakes for management purposes, restoration, protection and site specific monitoring.

Volunteers are supplied with sampling kits which include a Secchi disc, a composite water sampler, one litre bottles, magnesium carbonate preservative and instructions. Participants are requested to take weekly Secchi disc measurements and samples during the ice free period of the year. Water samples are preserved and shipped to the Technical Services Laboratory in Winnipeg, where they are analyzed for chlorophyll a. Analyses of the chlorophyll a and Secchi disc results reveal the relative trophic status of each lake. Long term sampling over a number of years is useful in the detection of trends related to nutrient enrichment.

It is essential that a sampling program on a lake be continued over a period of five to ten years in order to determine if there is a trend toward accelerated enrichment. In many lakes, temporary degradation of water quality occurs during periods of extensive algal blooms. The fluctuation in algal populations occurs both seasonally and from year to year, and is caused by environmental factors such as sunlight and chemical and biological activity. Over the long term, however, definite increases in chlorophyll a would be indicative of accelerated enrichment (eutrophication) which could be induced by the addition of man generated nutrients.

Sources of nutrients are sink and laundry wastes and seepage from septic tank systems and pit privies. All lake users should be aware of the potential problems which can be caused by these sources of nutrients and that they can contribute to the impairment of recreational and aesthetic water quality. If, over the long term, it becomes apparent that man generated nutrients are contributing to accelerated eutrophication, then the sources would have to be identified and steps would have to be taken to minimize their effects.

This report includes a map or maps showing stations, weekly chlorophyll *a* and Secchi disc values, mean annual chlorophyll *a* and Secchi disc values and trophic state indices. The trophic state indices (0-100), developed by Carlson (1977), are derived from mean annual chlorophyll *a* and Secchi disc values.

NOTE: Water taken from lakes for domestic uses should be boiled or disinfected and, as is stated in the Public Health Act of Manitoba,

"All surface waters should be considered unsafe for domestic purposes unless boiled or otherwise disinfected..."

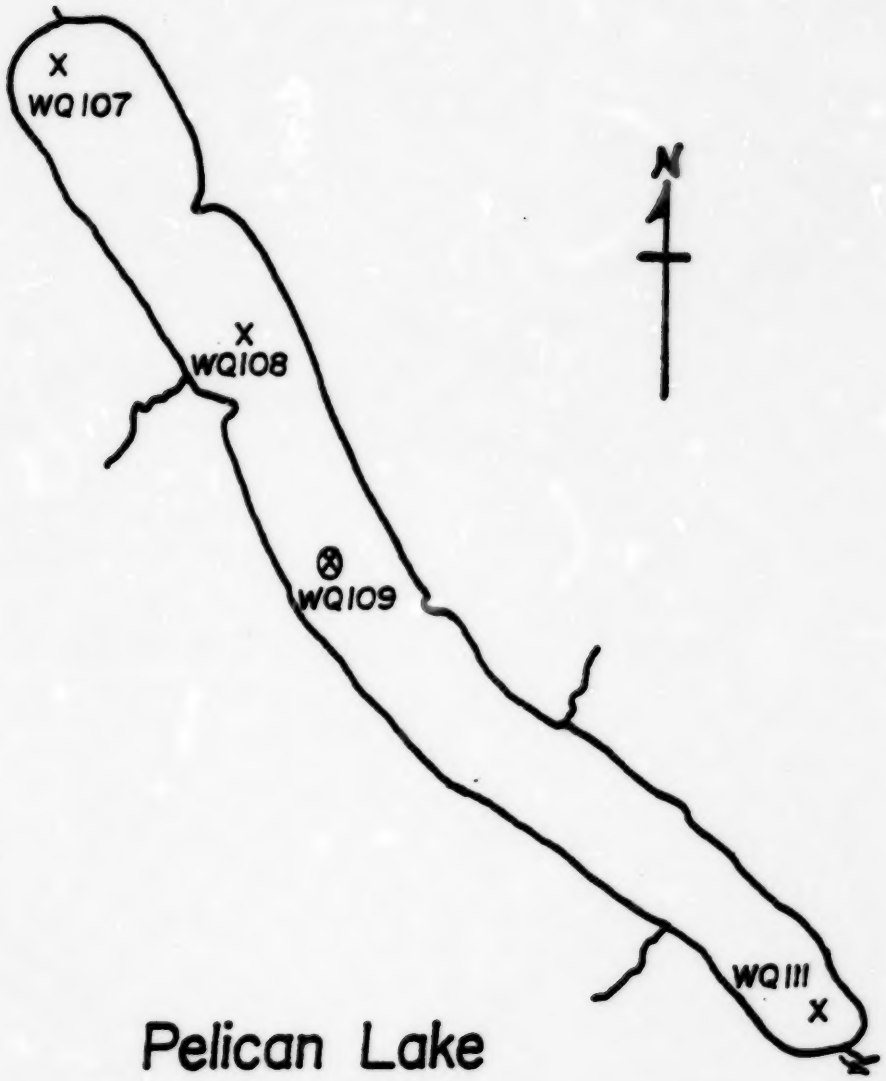
X
WQ 107
X
WQ108
WQ109
N
WQ 111
X
Pelican Lake
49°20' 99°32'
5 Kilometres
Stations X

FIGURE 1.

RESULTS AND DISCUSSION

Pelican Lake (Figure 1) was sampled at stations WQ107, WQ108, and WQ111 in 1979; at station WQ109 in 1980 and at stations WQ108 and WQ109 in 1981 and 1982. The weekly results for chlorophyll a and Secchi disc are shown as a mean result for three stations in 1979 and as individual results per station in 1980, 1981 and 1982(Tables 1 and 2).

Overall mean chlorophyll a values in 1979 and 1980 were relatively similar at 10.6 and 12.2 µg/1, respectively, while the overall mean chlorophyll a values noted in 1981 and 1982 were 52.2 and 49.1 µg/1 approximately 5 times the chlorophyll a noted in 1979 (Table 3 and (Figure 2). The high levels of chlorophyll a noted in 1981 and 1982 probably resulted because the nutrients available in the lake water were utilized more by unattached algae in 1981 than during the previous two years. In 1979 and 1980 blooms of the attached algae Cladophora sp. were noted and although the presence of this algae is generally indicative of relatively high nutrient levels it cannot be sampled by the chlorophyll a composite sampler. Therefore, it is likely that in 1979 and 1980 the chlorophyll a values did not accurately reflect the trophic status of the lake. During a heavy algae bloom which occurred on July 10 and 11, 1982 an algae sample was procured near station WQ109. The algae sample was made up entirely of Coelosphaerium Naegelianum but many other species were probably present in the lake at the same time and would have been present on other occasions.

The overall mean Secchi disc values decreased from 1.7 to 1.2 m from 1979 to 1980 and then dropped off substantially to 0.4 m in 1981 and 1982 (Table 2). The low Secchi disc values in 1981 were probably due to the increase in unattached algae suspended in the water column.

Pelican Lake is eutrophic or enriched in character. Carlson's (1977) trophic status indices (TSI) for chlorophyll a and Secchi disc indicated that there may have been a moderation in enrichment in 1979 and 1980 when TSI's ranged from 51.5 to 57.4 (Table 3). However, Cladophora sp. was also noted in the lake in 1979 and 1980 and this would have been indicative of more eutrophic conditions. The ISI, for chlorophyll a and Secchi disc at stations WQ108 and WQ109 showed a high eutrophic range of 61.8 to 78.6 in 1981 and 1982. Further sampling will be required to show whether the trophic state will stabilize or will remain at the high levels noted in 1981 and 1982.

TABLE 1: Mean chlorophyll *a* (ug/l) and Secchi disc (m) values for Pelican Lake during 1979 and 1980.

Date		Chlorophyll *a* (ug/l)[1]	Secchi Disc (m)[1]
May	22, 1979	29.5	1.0
May	29, 1979	19.4	1.1
June	6, 1979	12.4	0.9
June	12, 1979	6.1	1.3
June	19, 1979	2.1	2.3
June	26, 1979	1.7	3.2
July	3, 1979	2.0	2.3
July	10, 1979	1.4	2.6
July	17, 1979	3.5	2.1
July	24, 1979	5.7	2.0
July	31, 1979	3.4	2.0
August	7, 1979	8.0	1.3
August	14, 1979	13.9	1.3
August	21, 1979	24.3	0.8
August	25, 1979	27.1	0.8
May	19, 1980	2.2	2.0
May	27, 1980	18.3	1.5
May	31, 1980	1.1	2.0
June	10, 1980	2.9	1.5
June	15, 1980	6.0	1.5
June	23, 1980	4.9	2.0
July	1, 1980	9.2	1.5
July	8, 1980	7.2	1.5
July	13, 1980	8.7	1.0
July	22, 1980	7.9	1.0
July	28, 1980	7.3	0.8
August	5, 1980	10.3	0.8
August	11, 1980	11.8	0.8
August	17, 1980	27.6	0.9
August	24, 1980	10.8	0.8
August	31, 1980	44.8	0.5
September	9. 1980	26.0	0.5

Each reported value for 1979 is a mean of values collected from Stations WQ107, 108 and 111 and each reported value for 1980 is from Station WQ109 only.

Table 2: Mean chlorophyll a (ug/l) and Secchi disc (m) values for Pelican Lake during 1981 and 1982

Date		Station WQ108		Station WQ109	
		Chlorophyll a (ug/l)	Secchi Disc (m)	Chlorophyll a (ug/l)	Secchi Disc (m)
June	8, 1981	-	-	79.8	0.5
June	14, 1981	33.0	0.5	-	-
June	21, 1981	38.0	0.25	-	-
June	22, 1981	-	-	220.0	0.1
June	28, 1981	13.0	0.25	17.0	0.5
July	5, 1981	11.1	0.25	-	-
July	12, 1981	28.4	0.25	-	-
July	13, 1981	-	-	24.0	0.5
July	19, 1981	-	-	13.0	0.5
July	26, 1981	27.0	0.25	-	-
August	2, 1981	17.6	0.25	30.2	0.5
August	10, 1981	-	-	NA	0.5
August	17, 1981	-	-	87.8	0.5
August	27, 1981	-	-	59.0	0.4
September	6, 1981	-	-	88.2	0.4
September	13, 1981	-	-	109.0	0.4
September	23, 1981	-	-	44.0	0.4
June	3, 1982	-	-	7.0	0.8
June	9, 1982	-	-	13.2	0.7
June	15, 1982	-	-	14.6	0.6
June	20, 1982	6.5	0.3	-	-
June	23, 1982	-	-	13.6	0.6
June	29, 1982	15.0	0.3	-	-
July	4, 1982	35.0	0.3	-	-
July	11, 1982	-	-	117.0	0.3
July	13, 1982	53.1	0.25	-	-
July	18, 1982	132.0	0.2	-	-
July	19, 1982	-	-	121.0	0.3
July	26, 1982	-	-	89.2	0.3
August	3, 1982	-	-	23.3	0.3
August	15, 1982	38.0	0.25	-	-

TABLE 3: Mean chlorophyll a (ug/l) and Secchi disc (m) results at each station and the equivalent trophic state index (Carlson, 1977) for each parameter and station sampled in Pelican Lake during 1979, 1980, 1981 and 1982.

	1979			
	Chlorophyll a (ug/l)		Secchi Disc (m)	
Station	Mean	TSI	Mean	TSI
WQ107	8.5	51.6	1.7	52.3
WQ108	10.3	53.4	1.8	51.5
WQ109	—	—	—	—
WQ111	13.2	55.9	1.5	54.2
All Stations	10.8		1.7	

	1980			
Station	Mean	TSI	Mean	TSI
WQ107	—	—	—	—
WQ108	—	—	—	—
WQ109	12.2	55.1	1.2	57.4
WQ111				
All Stations	12.2		1.2	

	1981			
Station	Mean	TSI	Mean	TSI
WQ107	—	—	—	—
WQ108	24.0	61.8	0.3	78.1
WQ109	70.2	72.6	0.4	72.2
WQ111				
All Stations	52.2		0.4	

	1982			
Station	Mean	TSI	Mean	TSI
WQ107	—	—	—	—
WQ108	46.6	68.3	0.3	78.6
WQ109	51.0	69.1	0.5	70.4
WQ111				
All Stations	49.1		0.4	

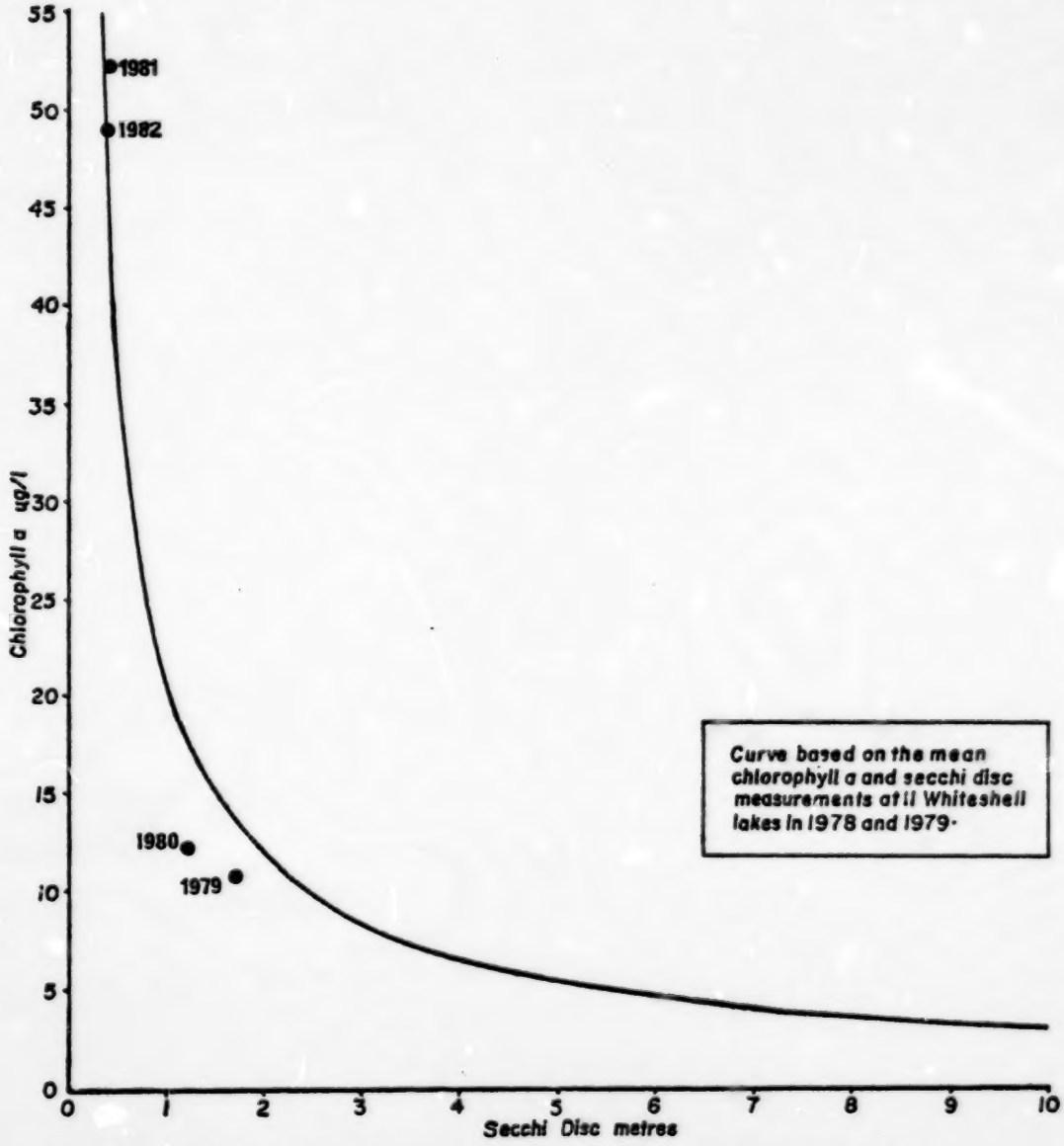

FIGURE 2: The Mean Chlorophyll a and Secchi Disc Values Collected on Pelican Lake

GLOSSARY OF TERMS

ALGAE - an assemblage of simple, mostly microscopic non-vascular plants containing photosynthetic pigments such as chlorophyll. Algae occur suspended in water (phytoplankton) and attached to rock and other suitable substrates. Some algae may produce nuisance conditions when environmental parameters are suitable for prolific growth.

CHLOROPHYLL - the photosynthetic green pigment which occurs in all groups of algae.

EUPHOTIC ZONE - the lighted region that extends vertically from the water surface to the level at which photosynthesis fails to occur due to insufficient light penetration.

EUTROPHIC - waters containing a rich supply of plant nutrients that support heavy growths of algae and aquatic plants. The increase in algae causes a decrease in the penetration of light. Deep areas may exhibit oxygen depletion due to the decomposition of dead organisms. Eutrophic lakes tend to be shallow and support warm water species of fish. The degradation in water quality renders the lake unsuitable for many recreational activities.

EUTROPHICATION - the process of becoming increasingly enriched in nutrients. It refers to the entire complex of changes which accompanies increasing nutrient enrichment. The result is the production of dense nuisance growths of algae and aquatic weeds which generally degrade water quality and render the lake unsuitable for many recreational activities. Accompanying the increase in algae is a decrease in game fish and an increase in coarse fish.

MESOTROPHIC - waters characterized by a moderate nutrient supply and organic production (i.e. midway between eutrophic and oligotrophic). The waters are suitable for most recreational activities.

OLIGOTROPHIC - waters containing a poor supply of plant nutrients resulting in little algae and aquatic plant growth. The waters are generally clear permitting extensive light penetration. Oxygen in the bottom waters is abundant. Oligotrophic lakes tend to be deep and support cold water fish such as lake trout and whitefish. The lakes are well suited for all types of recreational activities.

SECCHI DISC - a circular metal plate, 20 centimeters in diameter, the upper surface of which is divided into four equal quadrants and so painted that two quadrants directly opposite each other are painted black and the intervening ones white. The Secchi disc is used to estimate the depth of the euphotic zone.

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POOR

QUALITY

ORIGINAL